A revision of *Dielsiodoxa* (Ericaceae: Styphelioideae: Oligarrheneae)

David E. Albrecht [1,3] and Michael Hislop [2]

[1]Alice Springs Herbarium, Department of Natural Resources, Environment, the Arts and Sport, P.O. Box 1120, Alice Springs, NT 0871
[2]Western Australian Herbarium, Department of Environment and Conservation, Locked Bag 104, Bentley Delivery Centre, Western Australia 6983.
[3]Corresponding author, email: dave.albrecht@nt.gov.au

Abstract

Albrecht, D. E. & Hislop, M. A revision of *Dielsiodoxa* (Ericaceae: Styphelioideae: Oligarrheneae). *Nuytsia* 21(3): 107–126 (2011). The genus *Dielsiodoxa* Albr., endemic to south-west Western Australia, is revised. The genus includes three previously named species, *D. leucantha* (E.Pritz.) Albr., *D. oligarrhenoides* (F.Muell.) Albr. and *D. tamariscina* (F.Muell.) Albr. A neotype is designated for the former species and a lectotype for the latter species. Three new taxa are described with accompanying scanned images: *D. lycopodioides* Albr., *D. propullulans* Albr. and *D. leucantha* subsp. *obtusa* Hislop & Albr. Descriptions, a distribution map and a key to all taxa are provided.

Introduction

In a recent paper Albrecht *et al.* (2010) erected a new genus *Dielsiodoxa* Albr. to accommodate three Western Australian species previously included within *Monotoca* R.Br. Based on morphological and molecular data they place *Dielsiodoxa* in the Oligarrheneae Crayn & Quinn as a sister to *Oligarrhena* R.Br. *Dielsiodoxa* is distinguished from *Oligarrhena* in having a 5-lobed corolla that is not laterally compressed (*cf.* consistently 4-lobed and laterally compressed in *Oligarrhena*), the lobes widely spreading at anthesis and lacking adaxial sub-marginal flaps (*cf.* lobes erect and with sub-marginal flaps in *Oligarrhena*), 5 stamens with the anthers attached near the midpoint to filaments that distinctly taper upwards (*cf.* 2 stamens with basifixed anthers and filaments not obviously tapering distally in *Oligarrhena*).

The three currently named species of *Dielsiodoxa* (*D. tamariscina*, *D. oligarrhenoides* and *D. leucantha*) were described prior to 1905 as species of *Monotoca*. The taxonomy of this group of species has not been reassessed in the past century and the only treatment that includes all three species (as *Monotoca*) is in *How to know Western Australian wildflowers* (Blackall & Grieve 1981). At least one name was misapplied in that treatment and in some instances the species concepts are too broad. We have endeavoured to address these issues in the revision of *Dielsiodoxa* presented here, which is based on morphological data.

Methods

Morphological observations are based on collections held at CANB, MEL, NSW, PERTH and UNSW. Measurements were made with a binocular light microscope fitted with an eyepiece graticule. Dried material was rehydrated by boiling prior to measuring. Leaf measurements were made on fully expanded flattened leaves. Leaf density was assessed on well developed vegetative shoot growth below the actively expanding distal section. The width of the raised leaf abscission scars on branchlets was measured on dried material. Leaf vein number was assessed along an imaginary transverse line at the midpoint of the leaf. Leaf venation pattern was examined on representative specimens after soaking in bleach for several days. Peduncle length was measured as the distance between the base of the peduncle and the lowermost bract (sterile or subtending a flower or fruit). Fruit length measurements excluded the persistent style. Stigma cleft depth was measured as the vertical distance between the base of the cleft and an imaginary transverse line between the tips of the two stigmatic lobes.

Leaves and, to a lesser extent, flowers readily dissociate from specimens when they dry, and herbarium specimens frequently have fragments loose in the specimen folders or in packets attached to the specimen. Caution was exercised when examining such fragments as it was not uncommon to find fragments of other *Dielsiodoxa* species mixed with the species mounted on the sheet.

Details of growth form, plant height, flower colour, habitat and locality were taken from the collector's notes recorded on the herbarium specimen label. Geocode data from PERTH specimens were plotted using DIVA-GIS Version 5.2.0.2 to produce the distribution maps.

Morphology

Growth patterns. The way in which new growth is initiated on branchlets appears to vary between species and certainly has value in distinguishing *D. propullulans* and *D. leucantha*. The axis of fertile branchlets usually continues vegetative growth beyond the uppermost fertile nodes in most taxa, as exemplified in *D. propullulans*. Additionally, some taxa may initiate new growth from within or rarely below the fertile section. *Dielsiodoxa leucantha* on the other hand appears to initiate new growth almost exclusively from below the fertile section of the branchlet or occasionally produces very short, abortive growth beyond the uppermost fertile nodes. Further field study is required to confirm observations made from herbarium material.

Leaves. All species have dense, sessile leaves with lunate, non-sheathing bases. Most species have helical leaf arrangement with the exception of *D. oligarrhenoides*, which is decussate. *D. oligarrhenoides* also differs from other species in having thick-textured leaves with the venation not visible on the abaxial side. The number of veins has some utility in distinguishing *D. lycopodioides*, as does the width of scars left on the branchlets when the leaves abscise. Leaf shape, width and length/width ratio are useful diagnostic characters for some taxa when used in combination with other characters.

Differences in leaf shape and dimensions were noted between seedling and adult plants of *D. propullulans*. For example the seedlings represented on *J.M. Powell* 2231A have long, lanceolate leaves (e.g. approximately 4.2 mm long x 0.9 mm wide), whereas adult specimens of this species have considerably shorter and broader leaves. The sample of specimens taken from immature plants is presently too small to assess the occurrence of leaf dimorphism in the genus more generally.

Flowers. Members of the genus have tiny bisexual flowers with a persistent 5-lobed corolla, upwardly tapering filaments, exserted anthers that are distinctly concave abaxially, free nectary scales and a 2-locular ovary and 2-lobed stigma. Relatively few floral characters have taxonomic value. Bracteole and sepal apex shape varies within the genus and can be useful for distinguishing some taxa when used with other characters. The presence of hairs on the external surface of the corolla is distinctive for *D. tamariscina*, all other taxa having glabrous corollas. Further field work is required to determine whether there are any consistent differences in fresh corolla colour between taxa. All taxa have ovaries (and fruit) with a smooth or weakly textured surface except for *D. lycopodioides*, which has a distinctly pustulate surface, albeit minutely so.

Fruit. All species of *Dielsiodoxa* have a dry, indehiscent fruit. Following Albrecht *et al.* (2010), we have used the general term 'nut' to describe this fruit type, though the more specific term achene (*sensu* Stuppy 2004) also appears to be applicable.

Susceptibility to disease

It is probable that all species of *Dielsiodoxa* are susceptible to *Phytophthora cinnamomi*. This is particularly problematic for the taxa that have a very restricted geographical range. Formal declaration as threatened flora may be appropriate for some taxa, and specific conservation measures may need to be implemented to ensure the long-term persistence of some populations. Species-specific information where available, is given under the species treatments.

Research needs

Albrecht *et al.* (2010) included limited *Dielsiodoxa* sequence data from two chloroplast encoded regions in their analyses. The *mat*K gene and the *atp*B-*rbc*L intergenic spacer were successfully sequenced for *D. leucantha* subsp. *obtusa* and *D. propullulans*, and the *mat*K gene for *D. leucantha* subsp. *leucantha*. Around the time that the Albrecht *et al.* paper was submitted for publication, material of *D. lycopodioides* and *D. tamariscina* was sent to Chris Quinn at NSW for extraction and sequencing, however sequences for these two species were not successfully obtained. Further attempts to gain sequence data for these two species would be worthwhile. In addition, a more comprehensive infraspecific sampling, utilising several DNA markers, would be particularly valuable in the case of *D. leucantha*, by far the most variable species recognised here and one with a remarkably disjunct distribution pattern.

To the best of our knowledge chromosome counts have never been obtained for any species of *Dielsiodoxa*. Chromosome numbers may provide valuable additional data for assessing relationships.

Limited fire response data is available for *Dielsiodoxa* species. *Dielsiodoxa lycopodioides* [as *Monotoca tamariscina*] is recorded as a strict seeder by Bell (1995). Other genera in the Oligarrheneae, namely the monotypic *Oligarrhena* and *Needhamiella* L. Watson are also strict seeders (Bell 1995; Bell *et al.* 1996). It is likely that all species of *Dielsiodoxa* are strict seeders, however this needs confirmation by field observations or anatomical sectioning.

Taxonomy

Dielsiodoxa Albr., *Austral. Syst. Bot.* 23: 329–330 (2010). *Type*: *Dielsiodoxa tamariscina* (F.Muell.) Albr.

Shrubs, mostly small; branchlets with an indumentum of short simple hairs, dense raised leaf abscission scars evident on older branchlets; winter-bud scales similar to leaves, non-deciduous. *Leaves* dense, short, helical or decussate, erect to appressed, readily abscising from dried specimens when touched; primary veins subparallel-palmate, unbranched or outermost branched only in the proximal half, often weakly visible on abaxial side; fibre bundles not touching adaxial or abaxial epidermis; abaxial surface lacking both papillae and ribbon wax; the outer wall of epidermal cells unlignified and unthickened, collapsing inwards on drying; minute hairs or teeth present somewhere on margins; apex straight to incurved, mucronulate or not; base non-sheathing, lunate in transverse section, lacking a petiole. *Inflorescences* axillary, few-flowered spikes lacking a rudiment, sometimes reduced to a single flower; spikes with a persistent bract subtending each flower, with or without sterile proximal bracts. *Flowers* bisexual, each subtended by a pair of persistent bracteoles; bracteoles glabrous except for minutely ciliolate margins, inserted immediately below the sepals. *Sepals* 5, persistent, glabrous except for minutely ciliolate margins; stomata absent on adaxial surface, absent or rare near the margins on abaxial surface. *Corolla* radially symmetrical, white to pale yellowish-green, persistent in fruit and turning brown in dried material, glabrous or rarely with sparse short hairs externally; tube shallowly U-shaped, equal to or shorter than corolla lobes, equal to or slightly exceeding the sepals; lobes typically 5 (rarely 4, 6 or 7-lobed), valvate in bud, midvein apparent, widely spreading at anthesis, lacking adaxial sub-marginal flaps. *Stamens* equal to corolla-lobe number; anthers tiny, bisporangiate, lacking appendages, strongly exserted from the corolla tube at maturity, attached to filament near the midpoint in a depression between the two microsporangia; filaments inserted in the throat of the corolla tube, distinctly longer than anthers, fine and distinctly tapering upwards. *Pollen* all shed as prolate pseudomonads; exine infolds with verrucate ornamentation. *Nectary scales* free, chartaceous. *Ovary* exceeding corolla tube, glabrous, smooth or textured with weakly to distinctly raised surface cells, 2(3)-locular with apical placentation, with a single ovule in each cell, ovoid to ellipsoid, ellipsoid in transverse section, tapering to a very short style; stigma 2(3)-lobed. *Fruit* a nut, apparently only one seed developing.

A genus of five species, all endemic to the south west botanical province of Western Australia.

Key to species of *Dielsiodoxa*

Notes on using key to species. Due to leaf curvature and the small size of fertile organs it is advisable to assess fresh or rehydrated material, preferably with a microscope fitted with an eyepiece graticule. Leaf width dimensions (including those used in l/w ratios) in the key are based on flattened mature (not seedling) leaves. Fruit length excludes the persistent style. Stigma cleft depth is the vertical distance between the base of the cleft and an imaginary line between the tips of the two stigmatic lobes.

1. Leaves usually decussate, occasionally helically arranged on some branchlets, thick-textured, venation not evident on abaxial side; apex of sepals obtuse ..... **1. D. oligarrhenoides**

1: Leaves always helically arranged, thin-textured, venation at least weakly evident on abaxial side of some leaves; apex of sepals acute to obtuse 2

2. Outer surface of corolla tube and lower part of corolla lobes with sparse short hairs; restricted to the Stirling Ranges ..... **2. D. tamariscina**

2: Outer surface of corolla glabrous 3

3. Ovary and fruit appearing densely and minutely pustulate due to distinctly raised surface cells; fruit 0.8–1 mm long; mature leaves subulate, lanceolate, ovate or rarely narrowly rhombic, 0.8–5.2 mm long, 0.3–1.1 mm wide, with l:w ratio of 2–13:1; 1–7 veins weakly visible on the abaxial leaf surface; raised leaf abscission scars 0.10–0.35 mm wide ..... **3. D. lycopodioides**

3: Ovary and fruit smooth or with minute, dense, slightly raised, elongated surface cells; fruit 1.0–1.4 mm long; mature leaves ovate, depressed ovate to broadly rhombic-elliptic, 1.3–3.0 mm long, 0.9-2.5 mm wide, with l:w ratio of 0.7–2.1:1; 7–13 veins visible on the abaxial surface; raised leaf abscission scars (0.3–)0.4–0.7 mm wide 4

4. Axis of fertile branchlets usually continuing growth beyond the uppermost fertile nodes at anthesis, new growth sometimes also shooting from within fertile section of branchlet; leaves subtending inflorescences (from central part of fertile section of branchlet) broadly ovate, depressed ovate or rarely broadly rhombic-elliptic 1.5–2.2 mm wide, apex acute though sometimes appearing obtuse due to the abruptly incurved hidden tip that is at right angles to the axis of the leaf; shrub with comparatively few, mostly erect and straight branchlets; restricted to the Mt Ragged area ..... **D. propullulans**

4: Axis of fertile branchlets usually not continuing growth beyond the uppermost fertile nodes at anthesis, if occasionally vegetative shoot beginning to grow through, then these very short and abortive, new growth more often shooting from below fertile section of branchlet; leaves subtending inflorescences (from central part of fertile section of branchlet) broadly rhombic-elliptic to broadly rhombic-ovate 0.6–1.5 mm wide, apex acute to acuminate, almost straight to distinctly incurved, the tip usually at an angle of 45 degrees or less relative to the leaf axis, very occasionally at right angles; west of Ravensthorpe 5

5. Bracteoles usually acute or subacute, rarely obtuse, ovate to broadly ovate (usually longer than wide) 0.4–0.7 (–0.8) mm long; sepals usually acute or subacute, occasionally obtuse 0.7–1.1 mm long; corolla tube (0.65–) 0.75–1.00 mm long; nectary scales variously shaped from oblong, lanceolate, oblanceolate to narrowly elliptic, (0.30–) 0.45–0.70 mm long; stigma cleft 0.05–0.18 mm deep ..... **5a. D. leucantha** subsp. **leucantha**

5: Bracteoles usually obtuse, rarely subacute, broadly ovate to depressed-ovate (usually shorter than wide), 0.30–0.50 (–0.55) mm long; sepals usually obtuse, occasionally subacute, 0.50–0.75 (–0.85) mm long; corolla tube 0.5–0.8 mm long; nectary scales obovate to oblong-obovate, 0.25–0.40 (–0.55) mm long; stigma cleft 0.02–0.10 mm deep ..... **5b. D. leucantha** subsp. **obtusa**

Descriptions

1. Dielsiodoxa oligarrhenoides (F.Muell.) Albr., *Austral. Syst. Bot.* 23: 330 (2010).

Monotoca oligarrhenoides F.Muell., *Fragm.* 9: 47 (1875). *Styphelia oligarrhenoides* (F.Muell.) F.Muell., *Syst. Census Austral. Pl.* 107 (1882). *Type*: Prope promontorium Cape Arid [Western Australia, *s. dat.*], *G. Maxwell s.n.* (*holo*: MEL 607256!).

Monotoca oligarrhenoides subsp. Gibson (R.D. Royce 3573) in G.Paczkowska & A.R.Chapman, *West. Austral. Fl: Descr. Cat.* 242 (2000), *p.p.*

Erect, spreading or sprawling densely branched, often compact *shrub* c. 0.15–0.50 (–1) m high. *Main stems and branches* grey to grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* moderately fine, straight to somewhat curved, often entwined, grey-brown to brown, with an indumentum of variously orientated overlapping hairs 0.05–0.10 mm long, leaf abscission scars 0.3–0.8 mm wide. *Leaves* erect or ascending, decussate or occasionally helically arranged on some branchlets, densely imbricate with *c.* 20–48 leaves per cm, somewhat persistent in dried specimens but readily abscising when touched, rhombic to ovate, 0.7–2.0 mm long, 0.6–1.1 mm wide, thick-textured, rigid, strongly concave adaxially in proximal half and shallowly concave to more or less plane above, slightly keeled abaxially, adaxial and abaxial surfaces glabrous, concolorous, venation not visible; margins extremely narrow hyaline for the greater part, minutely ciliolate-serrulate, sometimes with longer hairs to 0.1 mm long on lower margins; apex not to slightly incurved, obtuse to subacute, lacking a mucro. *Inflorescences* (1)2 or 3(4)-flowered, borne on branchlets in a fertile section of variable length, the axis of fertile branchlets usually continuing growth beyond the uppermost fertile nodes at anthesis, new growth sometimes also shooting from within and rarely from below; *spike axis* 0.5–1.0 mm long including peduncle 0.3–0.6 mm long; *bracts* broadly rhomboid-ovate, often boat-shaped, 0.2–0.5 mm long, sterile proximal bracts absent or rarely 1 present; *bracteoles* broadly rhomboid-ovate, 0.3–0.5 mm long, 0.3–0.4 mm wide. *Sepals* ovate, 0.5–0.7 mm long, 0.3–0.5 mm wide, apex obtuse. *Corolla* (4)5(6)-lobed, mostly described as pale yellow in vivo at anthesis but label data also includes cream, greenish-white, yellow-green and green, presenting as rich brown post-anthesis in dried material, 1.5–1.9 mm long, glabrous; *tube* 0.6–0.8 mm long, mostly hyaline; *lobes* 0.8–1.2 mm long, 0.5–0.8 mm wide, acute to subacute. *Anthers* 0.2–0.3 mm long; free part of filaments 0.3–0.5 mm long. *Nectary scales* narrow elliptic to lanceolate, 0.3–0.7 mm long, 0.15–0.25 mm wide, acute to subacute. *Ovary* reddish (in rehydrated material), ovoid to ellipsoid, 0.8–1.1 mm long, 0.6–0.7 mm wide, textured by slightly raised elongated surface cells, 2-locular, style 0.1–0.2 mm long. *Fruit* dry and black in dried material, ovoid to ellipsoid, broadly ellipsoid to circular in cross-section, 1.0–1.3 mm long, 0.8–0.9 mm wide, smooth to finely textured by slightly raised elongated surface cells.

Specimens examined. WESTERN AUSTRALIA: 10 km due SSE of Mt Burdett, 2 Aug. 1983, *M.A. Burgman* 1635 *& S. McNee* (PERTH); 8.75 km due SE of Kau Rocks, 2.8 km SE of Mount Ney Road on Kau Rocks Road, 5 Sep. 1984, *M.A. Burgman & C. Layman* MAB 3531 (PERTH); Mallee Heath, 0.2 km SW of Tweedale Road on Muntz Road, Reserve 31799, Oct. 1984, *M.A. Burgman* 4300 (PERTH); 2 km W of Scaddan, 20 Aug. 1995, *R.J. Cranfield* 10202 (PERTH); N of Esperance, 4 Nov. 1901, *L. Diels* 5411 (PERTH); Lake Shaster Nature Reserve, off track running S from Springdale Road opposite Bedford Harbour Road, S of Munglinup, 26 Apr. 2008, *M. Hislop* 3761 (CANB, NSW, PERTH); 76.8 km E of Duke of Orleans Bay Road, 19 Sep. 1976, *R.J. Hnatiuk* 761032 (PERTH); *c.* 26 km SW of Israelite Bay and c. 160 km E of Esperance, 1 Oct. 1968, *E.N.S. Jackson* 1309 (AD, PERTH); 5 km E of Boyatup Hill, 11 Oct. 1983, *K. Newbey* 9796 (PERTH); Track to Point Malcolm, 4.5 km S of junction with Israelite Bay track, 29 Jul. 1986, *J.M. Powell* 2218 (DNA, NSW, PERTH); 2.6 km NW on Heywood Rd from junction with Karl Berg Rd, Esperance area, 5 Sep. 1986, *J.M. Powell* 2888 (NSW, PERTH, UNSW); 3 miles [*c.* 4.8 km] N of Gibson, 10 Aug. 1951, *R.D. Royce* 3573 (PERTH); 20 km E of Scaddan, 10 Sep. 1983, *P. van der Moezel* 290 (PERTH); 35 miles [*c.* 56.3 km] W of Esperance, 2 Sep. 1947, *J.H. Willis s.n.* (MEL); Approx. 48 km N of Esperance, 12 Sep. 1964, *P. Wilson* 3012 (AD, PERTH).

Distribution. Endemic to south-west Western Australia. Known from scattered locations between Scaddan and Point Malcolm, with an outlying western population near Lake Shaster (Figure 1).

Habitat. Available habitat information indicates that *D. oligarrhenoides* occurs on flat or slightly sloping terrain, sometimes near salt lakes, with deep, sandy soils, variously described as white, light grey or grey-brown, rarely with laterite present. *D. oligarrhenoides* occurs in heathland, tall scrub or very open shrub mallee. Associated dominants include species of *Banksia*, *Hakea*, *Grevillea*, *Melaleuca*, *Acacia* and mallee *Eucalyptus*.

Phenology. Flowering specimens have been collected between April and October.

Conservation status. A conservation nomination is presently considered unjustified, as a reasonable number of dispersed populations are known, including some with numerous plants. It occurs within Cape Arid National Park and other smaller conservation reserves.

Notes. Dielsiodoxa oligarrhenoides is readily distinguished by the presence of decussate leaves – a feature that is unique in the genus and is relatively uncommon in the Styphelioideae generally, where it is known in *Needhamiella* and some members of *Leucopogon* R. Br. *s.str.* and western '*Gynoconus*'. Although leaf venation is not apparent in *Dielsiodoxa oligarrhenoides*, cleared leaves show the typical *Dielsiodoxa* venation, though the veins (typically 5–7) are particularly broad in this species.

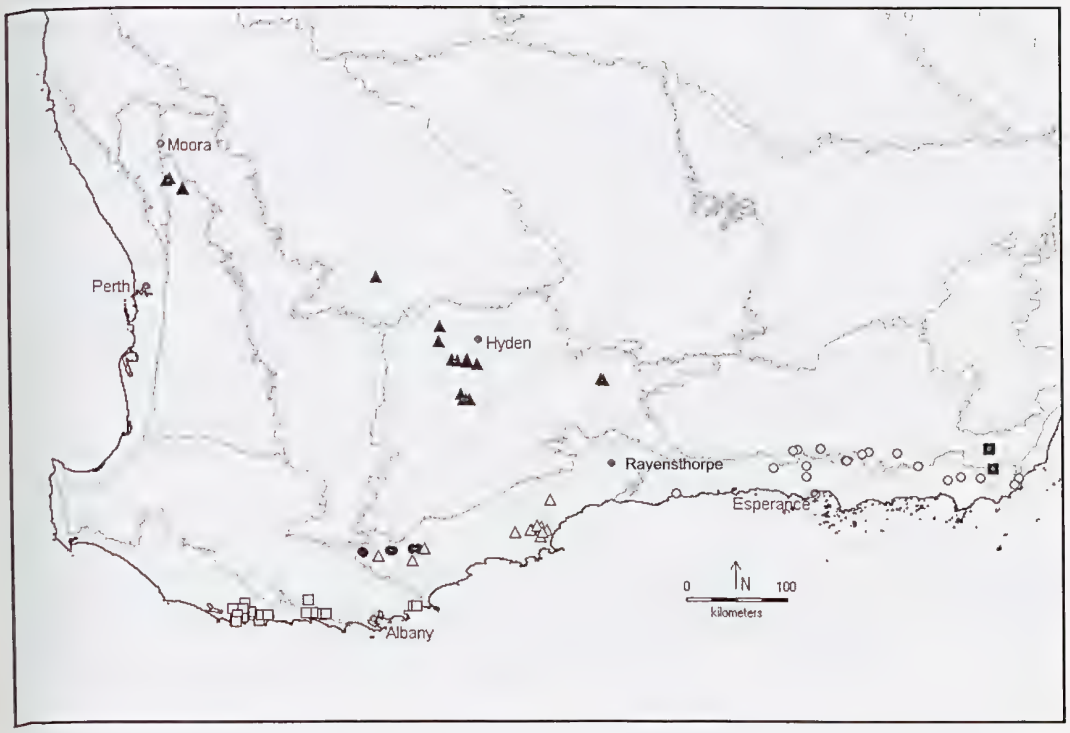

Figure 1. Distribution of *Dielsiodoxa leucantha* subsp. *leucantha* (▲), *Dielsiodoxa leucantha* subsp. *obtusa* (△), *Dielsiodoxa propullulans* (■), *Dielsiodoxa lycopodioides* (□), *Dielsiodoxa tamariscina* (●) and *Dielsiodoxa oligarrhenoides* (○) in Western Australia.

Blackall and Grieve (1981) misapplied the name *Monotoca oligarrhenoides*. The majority of specimens hitherto determined as *Monotoca oligarrhenoides* in Australian herbaria (probably largely based on Blackall and Grieve's concept) are *Dielsiodoxa propullulans*, and to a lesser extent *D. leucantha*, rather than *D. oligarrhenoides s.str.*

2. Dielsiodoxa tamariscina (F.Muell.) Albr., *Austral. Syst. Bot.* 23: 330 (2010). *Monotoca tamariscina* F.Muell., *Fragm.* 6: 79 (1867). *Styphelia minutiflora* F.Muell., *Fragm.* 11: 122 (1881). *Type*: In summis cacuminibus frigidiusculis montium Stirling's Ranges Australiae occidentalis inter rupes, [October 1867], *F. Mueller s.n.* (*lecto*, here designated: MEL 239718!; *isolecto*: MEL 239707!, MEL 239550!, MEL 2185965!, BM 001017993 digital image seen, K 000355600 digital image seen, K 000355602 digital image seen).

Illustration. W.E.Blackall & B.J.Grieve, *How to know W. Austral. Wildfl.* IIIB: 313 as *Monotoca tamariscina* (1981).

Erect to spreading densely branched *shrub c.* 0.1–0.5 (–1) m high. *Main stems and branches* grey to grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* moderately fine, straight to somewhat curved, often entwined, grey-brown to brown, with an indumentum of spreading or variously orientated overlapping hairs 0.05–0.25 mm long, leaf abscission scars 0.2–0.4 mm wide. *Leaves* erect or ascending, sometimes appressed on main stems, helical, densely imbricate with *c.* 30–85 leaves per cm, variably persistent in dried specimens (sometimes only the terminal leaves retained), readily abscising when touched, lanceolate, narrowly elliptic, rhombic or ovate, 1.0–5.0 mm long, (0.3–)0.5–1.5 mm wide, those towards the distal ends of branchlets generally shorter and broader than those on the main stems, thin-textured, concave to plane adaxially in proximal half and more or less plane above, curved to saddle-shaped in longitudinal section, not keeled abaxially, adaxial and abaxial surfaces glabrous or with sparse short hairs, concolorous, 3–7 veins visible at least on the abaxial surface; margins sometimes with an extremely narrow hyaline fringe, minutely ciliolate-serrulate to ciliate with hairs to 0.4 mm long; apex not to strongly incurved, acute to acuminate, lacking a mucro. *Inflorescences* 1–3-flowered, borne on branchlets typically in a long fertile section, the axis of fertile branchlets usually continuing growth beyond the uppermost fertile nodes at anthesis, new growth sometimes also shooting from within fertile section of branchlet; *spike axis* 0.4–2.0 mm long including peduncle 0.1–0.6 mm long; *bracts* broadly rhomboid-ovate, often boat-shaped, 0.2–0.6 mm long, sterile proximal bracts absent or 1 or 2 present; *bracteoles* broadly rhomboid-ovate, 0.3–0.5 mm long, 0.2–0.4 mm wide. *Sepals* ovate, 0.3–0.8 mm long, 0.2–0.5 mm wide, apex acute or subacute. *Corolla* 5(–7)-lobed, mostly described as white in vivo at anthesis but label data also includes cream, creamy-yellow and greenish-white, presenting as brown post-anthesis in dried material, (1.0–)1.2–2.0 mm long, with short hairs to 0.1 mm long on the tube and at least on the proximal portion of external surface of the lobes; *tube* 0.4–1.0 mm long, mostly somewhat hyaline (most pronounced when fruiting); *lobes* 0.5–1.1 mm long, 0.2–0.5 mm wide, acute to subacute. *Anthers* 0.15–0.30 mm long; free part of filaments 0.3–0.6 mm long. *Nectary scales* narrow elliptic, lanceolate to narrowly oblong, 0.2–0.5 mm long, 0.05–0.20 mm wide, acute to obtuse. *Ovary* somewhat reddish (in rehydrated material), ovoid to ellipsoid, 0.6–1.2 mm long, 0.4–0.7 mm wide, textured by slightly raised longitudinally elongated surface cells, 2(3)-locular, style 0.1–0.2 mm long. *Fruit* dry and brownish-black in dried material, ovoid to ellipsoid, broadly ellipsoid to circular in cross-section, 1.1–1.3 mm long, 0.8-1 mm wide, finely textured as in ovary but not pustulate.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 6 Dec. 1994, *S. Barrett* 114 (PERTH); 7 Oct. 1994, *S. Barrett* 173 (PERTH); 7 Mar. 1995, *S. Barrett* 285 (PERTH); 23 Apr. 1923, *C.A. Gardner* 1427 (PERTH); 23 Apr. 1923, *C.A.Gardner* 1927 (PERTH);

11 Oct. 1928, *C.A. Gardner* 2195 (PERTH); Oct. 1928, *Gardner & Blackall s.n.* (PERTH); 12 Nov. 1961, *A.S. George* 3128 (PERTH); 7 May 1982, *S.D. Hopper* 2336 (CANB, K, PERTH); 24 Oct. 1985, *N. Hoyle* 1226 (PERTH); 11 May 1982, *G.J. Keighery* 4829 (PERTH); 2 Jul. 1957, *A.R. Main s.n.* (PERTH); 5 Oct. 1970, *B.R. Maslin* 1120 (PERTH); 25 Oct. 1985, *E. & S. Pignatti* 1551 (PERTH); 27 Oct. 1959, *R.D. Royce* 6059 (PERTH).

Distribution. Endemic to the Stirling Ranges in south-west Western Australia (Figure 1). All known populations are within Stirling Ranges National Park.

Habitat. Occurs in heathland or mallee heathland, mostly on quartzite mountain ranges. Most collections have been made from the higher parts of ranges (i.e. 1000 m altitude and above). Plants typically grow in rock crevices.

Phenology. Flowering specimens have been collected between October and December.

Conservation status. Recent field observations strongly indicate susceptibility to *Phytophthora cinnamomi* (Sarah Barrett pers. comm.). Given the active threat posed by *Phytophthora cinnamomi* and the small number of known populations, this species has been recently listed as Priority Two under the Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora.

Typification. MEL 239718 has both flowers and fruit present and has been selected here as an appropriate lectotype.

There are some discrepancies between Mueller's protologue and the description presented here. Having examined all available material including a suite of specimens collected by Mueller (that includes the lectotype and isolectotypes), we believe that Mueller's protologue is in error with respect to the following features: presence of a narrow petiole, basally fused nectary scales and a 1-ovulate ovary.

Affinities. Blackall and Grieve (1981) had a broad species concept of *Monotoca tamariscina*, encompassing several taxa. Many specimens previously referred to *Monotoca tamariscina* are recognised in this treatment as *Dielsiodoxa lycopodioides*. Those specimens that are not *Dielsiodoxa lycopodioides* are either *D. tamariscina s. str.* or *D. leucantha* subsp. *obtusa*. *Dielsiodoxa tamariscina* differs from *D. lycopodioides* in having short hairs on the corolla tube and at least proximal part of corolla lobes externally (*cf.* glabrous in *D. lycopodioides*), non-pustulate ovary (*cf.* pustulate in *D. lycopodioides*) and larger fruits (1.1–1.3 mm long, *cf.* 0.8–1.0 mm long in *D. lycopodioides*).

Notes. Leaf shape, leaf indumentum and corolla size are rather variable in *D. tamariscina*.

Dielsiodoxa tamariscina occurs in the vicinity of *D. leucantha* subsp. *obtusa* and possibly *D. lycopodioides* (see notes under that species) in the central and eastern Stirling Ranges.

3. Dielsiodoxa lycopodioides Albr., *sp. nov.*

D. tamariscinae affinis sed corollis glabris, ovariis pustulatis, et fructibus parvioribus differt.

Typus: Mt Hopkins, Walpole-Nornalup National Park, Western Australia, 15 August 1979, *J.M. Powell* 1175 (*holo*: PERTH 03012530!; *iso*: AK *n.v.*, CANB!, CBG!, K *n.v.*, L *n.v.*, NSW!).

Monotoca sp.Walpole (B.J Lepschi 3666 & B.A.Fuhrer), Western Australian Herbarium, in *Florabase*, http://florabase.dec.wa.gov.au [accessed November 2010]; D.E.Albrecht, C.T.Owens, C.E.Weiller, & C.J.Quinn, *Austral. Syst. Bot.* 23: 320–332 (2010).

Illustration. J.Wheeler, N.G.Marchant & M.Lewington, *Fl. South West* 2: 606 (2002), as *Monotoca tamariscina.*

Erect to sprawling densely branched *shrub c.* 0.1–1.2(–2) m high. *Main stems and branches* grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* fine, straight to somewhat curved, often entwined, grey-brown to brown, with an indumentum of mostly spreading hairs 0.05–0.10(–0.20) mm long, leaf abscission scars 0.10–0.35 mm wide. *Leaves* erect or ascending, sometimes appressed on main stems, helical, densely imbricate with *c.* 30–70 leaves per cm, typically few persisting in dried specimens (sometimes only the terminal leaves retained), readily abscising when touched, subulate, lanceolate, ovate or rarely narrowly rhombic, 0.8–5.2 mm long, 0.3–1.1 mm wide, (current seasons leaves with l:w ratio of 2–13:1) those towards the distal ends of branchlets generally shorter and broader than those on the main stems, thin-textured, concave to plane adaxially in proximal half and more or less plane above, curved to saddle-shaped in longitudinal section, not keeled abaxially, adaxial and abaxial surfaces glabrous or occasionally scabridulous on the adaxial surface, concolorous, 1–7 veins weakly visible at least on the abaxial surface; margins sometimes with an extremely narrow hyaline fringe, minutely ciliolate-serrulate with hairs to *c.* 0.2 mm long; apex incurved or straight, narrowly acute to acuminate, mucronulate or occasionally lacking a mucro. *Inflorescences* 1–3(4)-flowered, borne predominantly along the length of fine lateral branchlets, the axis of fertile branchlets often determinate but sometimes the upper ones continuing growth beyond the uppermost fertile nodes at anthesis, new vegetative growth apparently also shooting from upper axils of main stems; *spike axis* 0.4–2.0 mm long including peduncle 0.1–0.8 mm long; *bracts* broadly ovate to rhomboid-ovate, often boat-shaped, 0.2–0.5 mm long, sterile proximal bracts absent or 1–5 present; *bracteoles* broadly rhomboid-ovate, 0.25–0.40 mm long, 0.2–0.4 mm wide. *Sepals* ovate to ovate-elliptic, 0.4–0.8 mm long, 0.2–0.4 mm wide, apex acute. *Corolla* (4)5-lobed, apparently white, pale greenish-white or pale yellowish-green in vivo at anthesis, presenting as brownish post-anthesis in dried material, 1.0–1.5 mm long, glabrous; *tube* 0.5–0.7 mm long, mostly hyaline (most pronounced when fruiting); *lobes* 0.6–1 mm long, 0.3–0.5 mm wide, acute to subacute. *Anthers* 0.15–0.30 mm long; free part of filaments 0.25–0.45 mm long. *Nectary scales* narrow elliptic, lanceolate to narrowly oblong, 0.3–0.5 mm long, 0.05–0.10 mm wide, acute to obtuse. *Ovary* somewhat reddish (in rehydrated material), ovoid to ellipsoid, 0.6–0.8 mm long, 0.4–0.5 mm wide, minutely pustulate, 2-locular, style 0.1–0.2 mm long. *Fruit* dry and brownish-black in dried material, ovoid to broadly ellipsoid-globose, broadly ellipsoid to circular in cross-section, 0.8–1.0 mm long, 0.6–0.8 mm wide, minutely pustulate. (Figure 2)

Selected specimens examined. WESTERN AUSTRALIA: Walpole-Nornalup National Park, 17 Dec. 1985, *A.R. Annels s.n.* (PERTH); Between Albany and Denmark, *c.* 1.25 km W of Hay River bridge, 2 Sep. 1959, *Hj. Eichler* 16082 (AD, PERTH); 1.3 km along Pool Road from junction with Jones Road, 40 metres to N of road, 13 Feb. 1997, *P. Ellery & C. Godden* W 45.3 (PERTH); Rudyard, Wilsons Inlet, E of Denmark, 13 Jan. 1953, *R. Erickson s.n.* (PERTH); Near Boggy Lake, 6 m [*c.* 9.6 km] SW of Walpole, 2 Dec. 1956, *J.W. Green* 936 (PERTH); Coalmine Beach, Walpole-Nornalup National Park, 12 Aug. 1981, *W. Greuter s.n.* (NSW); Valley of the Giants Road, *c.* 14.5 km E of Walpole, 25 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer* BJL 3666 (MEL, PERTH); 2.4 km W of Angrove Road / Centre Road intersection, 20 metres S of Centre Road, 13 Feb. 1997, *C. McChesney & C. Day* W 36.2 (PERTH); River flow meter area, 2 km NE of Break Rd junction on Denmark River, *c.* 15 km NW of Denmark, 1 Feb. 1980, *J.M. Powell* 1422 (MEL, NSW, PERTH); Mt Manypeaks, E ridge

Figure 2. Holotype of *Dielsiodoxa lycopodioides* Albr. (PERTH 03012530), scale = 2cm.

track and plateau area, 27 Aug. 1986, *J.M. Powell* 2662 (HO, NSW, PERTH); 4 miles [*c.* 6.4 km] W of Denmark, 17 Sep. 1966, *E.M. Scrymgeour* 1152 (PERTH); Approx. 1 Meile [mile = *c.* 1.6 km] W Denmark, 4 Nov. 1963, *H.U. Stauffer* 5376 *& R.D. Royce* (PERTH); Site 136, 7 km SW of Mount Frankland, 3 Sep. 1997, *D. Trenowden* 057 (PERTH); Deep River bridge between Walpole and Weld River, 13 Sep. 1963, *J.H. Willis s.n.* (MEL, PERTH).

Distribution. Endemic to south-west Western Australia. Collections have been made from three discrete areas centred on Walpole, Denmark and Mt Manypeaks (Figure 1). These places are amongst the wettest in south-west Western Australia.

Habitat. Occurs in a range of habitats including rocky hillsides, sandy, loamy or gravely flat terrain, and somewhat swampy areas. Associated vegetation is equally diverse floristically and structurally, including forest, woodland, shrubland, scrub and heathland. Frequently recorded associated taxa include *Eucalyptus marginata*, *Corymbia calophylla*, and species of *Agonis*, *Taxandria*, *Acacia*, *Allocasuarina* and *Pteridium*.

Phenology and reproductive biology. Flowering specimens have been collected between March and November. Keighery (1996: 352), based on observations made by J.S. Pate at Denmark, states that *Dielsiodoxa lycopodioides* [as *Monotoca tamariscina*] is pollinated by mosquitoes and tipulid flies.

Conservation status. A reasonable number of good sized populations are known and a conservation nomination is presently considered unjustified. However, the species has been noted [as *Monotoca tamariscina*] as susceptible to *Phytophthora cinnamomi* (Lyons 2008), and it is conceivable that populations could decline in the future. It occurs within Walpole-Nornalup National Park.

Etymology. The epithet indicates a superficial resemblance to some members of the family Lycopodiaceae.

Affinities. *Dielsiodoxa lycopodioides* as here defined was included under *Monotoca tamariscina* by Blackall and Grieve (1981). *Dielsiodoxa lycopodioides* is similar to *D. tamariscina* but differs in having glabrous corollas, minutely pustulate ovaries and smaller fruits. Although herbarium data indicates that *Dielsiodoxa lycopodioides* plants are variable in height, they are probably generally taller than *D. tamariscina*. A distinctive feature of *Dielsiodoxa lycopodioides* plants are their very fine branchlets.

Notes. Two specimens from the Stirling Ranges are tentatively placed here although they are not mapped in Figure 1. The material is poor and it has not been possible to confidently determine whether they are aberrant *Dielsiodoxa lycopodioides* or an undescribed taxon. These specimens—Stirling Ranges, 13 Nov. 1944, *R.J. Moir s.n.* (PERTH 03012484) and Bluff Knoll, Stirling Ranges, 12 Nov. 1961, *A.S.George 3127* (PERTH 02570408)—appear to be similar to *D. lycopodioides* but have a very short corolla tube and distinctly elongated papillae on the distal half of the ovary. Further fertile specimens including flowers and fruits are required to resolve the status of this material.

4. Dielsiodoxa propullulans Albr., *sp. nov.*

D. leucanthae affinis sed axe ramulorum fertilium sub anthesi.plerumque ultra nodis fertililibus supremis extenso et foliis latioribus inflorescentiis subtentis differt.

Typus: SW base of Mt Ragged Western Australia, 24 Nov. 1985, *A.N. Rodd* 5176 (*holo*: PERTH 01178369!; *iso*: NSW!).

Monotoca sp. Mt Ragged (C.A. Gardner 2860), Western Australian Herbarium, in *Florabase* http://florabase.dec.wa.gov.au [accessed November 2010]; D.E.Albrecht, C.T.Owens, C.E.Weiller, & C.J.Quinn, *Austral. Syst. Bot.* 23: 320–332 (2010).

Dielsiodoxa oligarrhenoides auct. non (F.Muell.) Albr.: W.E.Blackall & B.J.Grieve, *How to know W. Austral. Wildfl.* IIIB: 313 (1981).

Illustration. W.E.Blackall & B.J.Grieve, *How to know W. Austral. Wildfl.* IIIB: 313 (1981) as *Monotoca oligarrhenoides*.

Erect multi-stemmed *shrub c.* 0.1–1 m high. *Main stems and branches* grey to grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* moderately coarse, straight rarely curved, grey-brown to brown, with an indumentum of variously orientated overlapping hairs 0.05–0.10 mm long, leaf abscission scars 0.4–0.7 mm wide. *Leaves* erect, helical, densely imbricate with *c.* 30–50 leaves per cm, typically many persisting in dried specimens, readily abscising when touched, broadly ovate, depressed ovate or rarely broadly rhombic-elliptic, 1.3–3.0 mm long, 1.3–2.5 mm wide, (current seasons leaves with l:w ratio of 0.7–1.6:1), moderately thin-textured, concave adaxially in proximal half and more or less plane above, saddle-shaped in longitudinal section, not keeled abaxially, adaxial and abaxial surfaces glabrous, concolorous, 7–13 veins weakly visible at least on the abaxial surface; margins with an extremely narrow hyaline fringe, minutely ciliolate-serrulate, sometimes with longer hairs to 0.1mm long on lower margins; apex acute although sometimes appearing obtuse due to the hidden tip that is at right angles to the axis of the leaf, abruptly incurved, mucronulate or rarely lacking a mucro. *Inflorescences* 1–4(–6)-flowered, borne on branchlets in a comparatively long fertile section, the axis of fertile branchlets usually continuing growth beyond the uppermost fertile nodes at anthesis, new growth sometimes also shooting from within fertile section of branchlet; *spike axis* 0.7–2.0 mm long including peduncle 0.3–1.0 mm long; *bracts* ovate to rhomboid-ovate, often boat-shaped, 0.2–0.5 mm long, sterile proximal bracts absent or 1 or 2(–4) present; *bracteoles* broadly ovate to broadly rhomboid-ovate, 0.3–0.4 mm long, 0.2–0.4 mm wide. *Sepals* ovate to ovate-elliptic, 0.6–0.9 mm long, 0.4–0.5 mm wide, apex obtuse or subacute. *Corolla* 5-lobed, mostly described as white or cream in vivo at anthesis but label data also includes greenish-white or yellowish-green, presenting as brown post-anthesis in dried material, 1.4–2.0 mm long, glabrous; *tube* 0.5–0.8 mm long, mostly hyaline (most pronounced when fruiting); *lobes* 0.7–1.2 mm long, 0.4–0.6 mm wide, acute to subacute. *Anthers* 0.15–0.30 mm long; free part of filaments 0.3–0.6 mm long. *Nectary scales* narrowly lanceolate-deltoid to linear, 0.3–0.5 mm long, 0.05–0.15 mm wide, acute to obtuse. *Ovary* somewhat reddish (in rehydrated material), ovoid, ellipsoid or obovoid, 0.8–1.2 mm long, 0.5–0.7 mm wide, textured by slightly raised elongated surface cells, 2(3)-locular, style 0.1–0.2 mm long. *Fruit* dry and brownish-black in dried material, ovoid to broadly ellipsoid-globose, broadly ellipsoid to circular in cross-section, 1.1–1.4 mm long, 0.8–1.1 mm wide, almost smooth to textured by slightly raised elongated surface cells. (Figure 3)

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 6 Jan. 1979, *B. Barnsley* 289 (CANB, NSW); 16 Apr. 1995, *S. Barrett* 357 (PERTH); 10 Apr. 1974, *M.I.H. Brooker* B4512 (PERTH); 1 Jul. 1976, *D.J. McGillivray* 3620 & *A.S. George* (NSW, PERTH); 21 Sep. 2002, *P.M. Olde* 02/232 & *N. Marriott* (NSW); 30 Jul. 1986, *J.M. Powell* 2231 (NSW, PERTH); 30 Jul. 1986, *J.M. Powell* 2231A (NSW, PERTH); 24 Nov. 1985, *J.M. Powell* 3469 (NSW); 5 Dec. 1971, *R.D. Royce* 10112 (PERTH); 18 May 1967, *P.G. Wilson* 5850 (PERTH); 1 Nov. 1968, *J.W. Wrigley s.n.* (CANB, NSW).

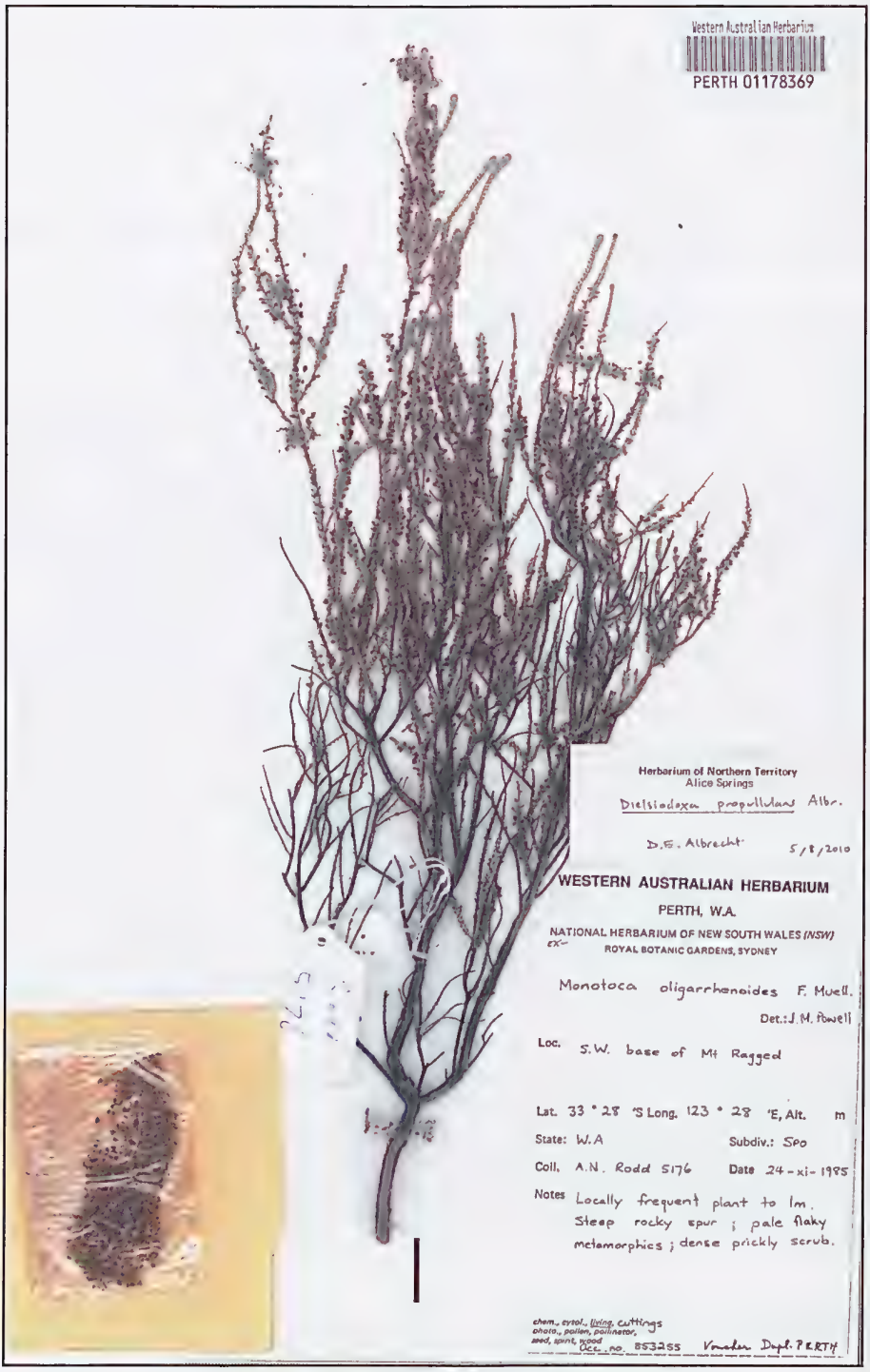

Figure 3. Holotype of *Dielsiodoxa propullulans* Albr. (PERTH 01178369), scale = 2cm.

Distribution. Endemic to the Mt Ragged massif and The Diamonds Hill in south west Western Australia (Figure 1). All known populations occur within Cape Arid National Park.

Habitat. Occurs in heathland, low scrub or heathy mallee on rocky or gravely hills. Recorded as occurring on quartzite, granite and gneiss geologies, with sandy to loamy soils. Associated taxa include *Eucalyptus doratoxylon*, *E. tetraptera*, *Taxandria linearifolia*, *Banksia prolata* subsp. *archeos* and *Gastrolobium pycnostachyum.*

Phenology. Flowering specimens have been collected between March and August, and between October and January, but it probably flowers throughout the year if conditions are suitable.

Conservation status. Recently listed as Priority Two under DEC Conservation Codes for Western Australian Flora. Although currently locally common, the highly restricted distribution of this species may jeopardize its chances of survival if subjected to a significant threatening process, such as *Phytophthora cinnamomi.*

Etymology. The epithet derives from the Latin *propullulans* (shooting forth), and refers to the way in which the axis of fertile branchlets usually extends beyond the uppermost fertile nodes at anthesis.

Affinities. Dielsiodoxa propullulans is most similar to *D. leucantha*, the two differing in regard to the character of the leaves subtending the inflorescences and in the way new growth is initiated on fertile branchlets. *D. propullulans* has inflorescence-subtending leaves which are broadly ovate to depressed ovate, 1.5–2.2 mm wide and with an apex at right angles to the axis of leaf. In *D. leucantha* by contrast these leaves are broadly rhombic-elliptic to broadly rhombic-ovate, 0.6–1.5 mm wide and usually with the apex at an angle of 45 degrees or less relative to the leaf axis. And whereas *D. propullulans* usually has strong new growth continuing beyond the upper fertile nodes, in *D. leucantha* new growth issues from below the fertile section of the branchlet. The two species are allopatric with *D. propullulans* occurring more than 300 kilometres to the east of the easternmost known population of *D. leucantha.*

Notes. The name *Monotoca oligarrhenoides* was misapplied by Blackall and Grieve (1981) to specimens here treated as *Dielsiodoxa propullulans.*

5. Dielsiodoxa leucantha (E.Pritz.) Albr., *Austral. Syst. Bot.* 23: 330 (2010). *Monotoca leucantha* E.Pritz. in Diels & E.Pritz., *Bot. Jahrb. Syst.* 35: 480, fig. 53 (1904). *Type citation*: 'in distr. Avon septentrionali pr. Moore River in lapidosis montium "Babilon Hills" flor. m.', August [1901], *L. Diels* 4028 (*holo*: B, *n.v.*, presumably destroyed in WWII). *Neotype*: Babilion Hills, Mogumber, Western Australia, 25 September 1934, *C.A. Gardner s.n.* (*neotype,* here designated: PERTH 01244922!; *isoneotypes*: CANB!, K!, MEL!, NSW!).

Erect densely branched *shrub* 0.2–1.3 m high. *Main stems and branches* grey to grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* moderately fine, straight to curved, grey-brown to brown, with an indumentum of variously orientated overlapping hairs 0.05–0.10 mm long, leaf abscission scars (0.3–)0.4–0.7 mm wide. *Leaves* erect, helical, densely imbricate with *c.* 24–50 leaves per cm, typically many persisting in dried specimens, readily abscising when touched, broadly rhombic-elliptic to broadly rhombic-ovate, 1.3–3.0 mm long, 0.9–1.7 mm wide, (current seasons leaves with l:w ratio of 1–2.1:1), moderately thin-textured, concave adaxially in proximal half and more or less plane above, saddle-shaped in longitudinal section, not keeled abaxially, adaxial and abaxial

surfaces glabrous, concolorous, 7–11 veins usually weakly visible at least on the abaxial surface; margins usually with an extremely narrow hyaline fringe, minutely ciliolate-serrulate, sometimes with longer hairs to 0.1mm long on lower margins; apex acute to acuminate, almost straight to incurved, with the tip very occasionally at right angles to the axis of the leaf, lacking a mucro or mucronulate. *Inflorescences* 1–5-flowered, borne on branchlets in a distal fertile section, the axis of fertile branchlets not continuing growth beyond the uppermost fertile nodes at anthesis, or producing very short abortive growth, new growth more often shooting from below fertile section of branchlet; *spike axis* 0.7–2.5 mm long including peduncle 0.3–1.0 mm long; *bracts* ovate to rhomboid-ovate, often boat-shaped, 0.1–1.0 mm long, sterile proximal bracts typically 2, rarely only 1 or 3–5 present; *bracteoles* ovate to depressed ovate, 0.3–0.8 mm long, 0.3–0.6 mm wide, acute to obtuse. *Sepals* ovate-elliptic, ovate, broadly ovate to almost orbicular, 0.5–1.1 mm long, 0.30–0.65 mm wide, acute to obtuse. *Corolla* 5-lobed, white to cream in vivo at anthesis (rarely recorded as pale yellow), presenting as brown post-anthesis in dried material, 1.5–2.1 mm long, glabrous; *tube* 0.5–1.0 mm long, mostly hyaline (most pronounced when fruiting); *lobes* 0.9–1.3 mm long, 0.5–0.8 mm wide, acute to subacute. *Anthers* 0.15–0.40 mm long; free part of filaments 0.3–0.8 mm long. *Nectary scales* narrowly elliptic, lanceolate, oblong, oblanceolate or obovate, 0.25–0.70 mm long, 0.10–0.25 mm wide, acute to obtuse, sometimes bilobed. *Ovary* somewhat reddish (in rehydrated material), ovoid to ellipsoid, 0.8–1.2 mm long, 0.5–0.7 mm wide, textured by slightly raised elongated surface cells, 2-locular, style 0.1–0.2 mm long, stigma cleft 0.02–0.18 mm deep. *Fruit* dry and brownish-black in dried material, ovoid to broadly ellipsoid, circular in cross-section, 1.0–1.4 mm long, 0.6–1.0 mm wide, almost smooth to textured by slightly raised elongated surface cells.

Typification. Specimens of Ericaceae subf. Styphelioideae were apparently among those that were completely destroyed by the bombing raids of Berlin during the Second World War (Botanical Museum Berlin-Dahlem 1999). According to Stafleu and Cowan (1976), Diels' Australian specimens are also housed at BM, CANB and MEL. An attempt to relocate type material at these institutions has proven unfruitful. Although the protologue includes an excellent illustration we have opted to designate a specimen as the neotype rather than rely solely on the illustration. The neotype is from the same small range of hills as the holotype and conforms well with the protologue.

Affinities. In general appearance *Dielsiodoxa leucantha* resembles *D. oligarrhenoides* but is readily distinguished by the strictly helical, rather than mostly decussate, leaf arrangement. It shares a number of features with *Dielsiodoxa propullulans*, differing in the shape, width and apex of leaves subtending the inflorescence and the way new growth is initiated on fertile branchlets. These differences are presented in detail under *D. propullulans*.

Two geographically separated subspecies are recognised.

Dielsiodoxa leucantha (E.Pritz.)Albr. subsp. **leucantha**

Illustrations. Diels & E.Pritz, *Bot. Jahrb. Syst.* 35: 480–481 (1904) as *Monotoca leucantha*; W.E.Blackall & B.J.Grieve, *How to know W. Austral. Wildfl.* IIIB: 313 (1981) as *Monotoca leucantha*.

Bracteoles usually acute or subacute, rarely obtuse, ovate to broadly ovate (usually longer than wide) 0.4–0.7 (–0.8) mm long. *Sepals* usually acute or subacute, occasionally obtuse 0.7–1.1 mm long. *Corolla tube* (0.65–)0.75–1.0 mm long. *Nectary scales* variously shaped from oblong, lanceolate, oblanceolate to narrowly elliptic, (0.3–)0.45–0.70 mm long. *Stigma cleft* 0.05–0.18 mm deep.

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 16 Sep. 1992, *B. & B. Backhouse* BM168 (PERTH); 29 Apr. 1994, *R.M. Buehrig* 94.04.29 (10) (PERTH); 9 Sep. 1996, *A.M. Coates, R. Cugley, E. Bishop & J. Stewart* 4418 (CANB, PERTH); 12 Oct. 2003, *D.M. Crayn* 723 (K, NSW, NYBG, PERTH, WFU); 14 Nov. 1990, *E.A. Griffin* 6150 (PERTH); 3 Sep. 1970, *K.R. Newbey* 3351 (PERTH).

Distribution. Endemic to south-west Western Australia. This taxon has an unusual and rather anomalous distribution comprising two very disjunct population nodes—a small western one near Mogumber (south of Moora), and a larger eastern occurrence centred to the east and south-east of Hyden. The eastern node itself has a couple of outlying populations near Bruce Rock and Hatters Hill (Figure 1). This subspecies has the most northerly and inland distribution of any member of the genus.

Habitat. Populations occur in open woodland, heathland or open shrub mallee and are usually associated with breakaways, often with white soils and quartz and/or lateritic gravel.

Phenology. Flowering specimens have been collected between July and October.

Conservation status. Dielsiodoxa leucantha is currently listed as Priority Three under DEC Conservation Codes for Western Australian Flora (Smith 2010), under the name *Monotoca leucantha.* Although there is no obvious justification for maintaining either subspecies on the Priority List, the situation in relation to the typical subspecies is complicated by the fact that, as circumscribed here, the latter comprises two forms which are widely separated geographically. The western or type form, is currently known from just two populations, only one of which is protected in the Conservation Estate. The only significant difference between it and the eastern form appears to be that it has narrower corolla lobes and there is also a tendency to larger leaves. The authors felt that, in the absence of other data, this morphological basis was inadequate for the recognition of another taxon. However, although apparently slight, the corolla difference is consistent. In these circumstances, because of the conservation implications, it would be desirable to utilize molecular sequence data to investigate relationships between the different forms of this subspecies (and including subsp. *obtusa*), in order to assess whether the classification used here requires modification. Following the precautionary principle, until such time as a study of this kind can be undertaken, this taxon will remain Priority 3.

Dielsiodoxa leucantha (E.Pritz.) Albr. subsp. **obtusa** Hislop & Albr., *subsp. nov.*

D. leucanthae subsp. *leucanthae* affinis sed bracteolis et sepalis obtusis, sepalis, tubo corollae et squamis nectarii brevioribus differt.

Typus: Fitzgerald River National Park, Mount Maxwell, track to lookout, Western Australia, 16 July 2010, *C. Puente-Lelièvre & E.A. Brown* CPL 93 (*holo*: PERTH 08228655!; *iso*: MEL!, NSW!).

Monotoca leucantha subsp. Stirling Range (D.M. Crayn 80); D.E.Albrecht, C.T.Owens, C.E.Weiller, & C.J.Quinn, *Austral. Syst. Bot.* 23: 320–332 (2010).

Bracteoles usually obtuse, rarely subacute, broadly ovate to depressed-ovate (usually shorter than wide), 0.30–0.50 (–0.55)mm long. *Sepals* usually obtuse, occasionally subacute, 0.50–0.75 (–0.85) mm long. *Corolla tube* 0.5–0.8 mm long. *Nectary scales* obovate to oblong-obovate, 0.25–0.40 (–0.55) mm long. *Stigma cleft* 0.02–0.10 mm deep. (Figure 4)

Selected specimens examined. WESTERN AUSTRALIA: Bell Track ca 4.5 km S of northern (internal) fireline, 24 Mar. 2004, *S. Barrett* 1212 (PERTH); Stirling Range National Park, Hosteller Hills, 21 Jun. 2007, *S. Barrett* 1613 (PERTH); 30m along trail to Pillenorup Swamp after entering Stirling Range National Park on Chester Pass Rd from the South, 2 Oct. 1995, *D.M. Crayn* 68 (UNSW); Fitzgerald River National Park, 1–2 km N of Quaalup, 19 Oct. 1991, *W. Greuter* 22985 (PERTH); Ridgeline below Ellen's Peak, SW Stirling Ranges, 11 May 1982, *G.J. Keighery* 4938 (PERTH); Mt Bland, 6 Apr. 1963, *K.R. Newbey* 734 (PERTH); Mt Maxwell, slopes below summit, 17 Nov. 1985, *J.M. Powell* 3336 (NSW, PERTH); West Mt Barren, 18 Nov. 1985, *J.M. Powell* 3363 (NSW, PERTH, HO).

Distribution. Endemic to south-west Western Australia, where it is apparently confined to the Fitzgerald River and Stirling Ranges National Parks (Figure 1). Its distribution lies well to the south of the typical subspecies.

Habitat. Occurs in heathland or mallee heath, usually on hillslopes with stony or rocky sandy (rarely peaty-sand) soils. Recorded once on a flat depression with deep white sand. Occurs in the vicinity of *Dielsiodoxa tamariscina* in the eastern Stirling Ranges.

Phenology. Flowering specimens have been collected between March and September.

Conservation status. This taxon is locally common in the Fitzgerald River National Park and no conservation code is recommended here. However, because it is very likely to be susceptible to *Phytophthora cinnamomi* its status may need to be reviewed as that pathogen inevitably spreads within the park.

Etymology. The epithet refers to the obtuse bracteoles and sepals.

Notes. Because of limited overlap in most of the characters used to separate this taxon from typical *D. leucantha*, the rank of subspecies was considered the most appropriate to apply. However the two taxa are generally easily distinguished from each other, subsp. *obtusa* differing in its shorter usually obtuse bracteoles and sepals, shorter corolla tube, shorter and broader nectary scales, and less deeply cleft stigma. In addition there are potential differences in habit and phenology that need further investigation. As suggested above a molecular study of infraspecific relationships within *D. leucantha* would be particularly valuable and may indicate that subsp. *obtusa* is better treated as a separate species.

Acknowledgements

We thank the directors of CANB, MEL, NSW, PERTH and UNSW for loan of specimens and access to their collections. John Hunnex (BM) and Clare Drinkell (K) kindly checked collections at their herbaria and sent digital images of potential types. Neville Walsh, Graham Bell and Brendan Lepschi checked for types at MEL, AD and CANB respectively. Paul Wilson provided nomenclatural advice and prepared the Latin diagnoses, and Juliet Wege prepared the distribution map. Rob Davis, Sarah Barrett and Mavis Sowry kindly went out of their way to collect DNA samples of *Dielsiodoxa*. We also acknowledge Chris Quinn's invaluable support and Kevin Thiele's assistance in facilitating the completion of this work.

Figure 4. Holotype of *Dielsiodoxa leucantha* subsp. *obtusa* Hislop & Albr. (PERTH 08228655), scale = 2 cm.

References

Albrecht, D.E., Owens, C.T., Weiller, C.E. & Quinn, C.J. (2010). Generic concepts in Styphelieae: the *Monotoca* group. *Australian Systematic Botany* 23: 320–332.

Bell, T.L. (1995). *Biology of Australian Epacridaceae: with special reference to growth, fire response and mycorrhizal nutrition.* PhD thesis, Department of Botany, University of Western Australia, p 251.

Bell, T.L., Pate, J.S. & Dixon, K.W. (1996). Relationships between fire response, morphology, root anatomy and starch distribution in south-west Australian Epacridaceae. *Annals of Botany* 77: 357–364.

Blackall, W.E. & Grieve, B.J. (1981). *How to know Western Australian wildflowers*. Part IIIB, 2nd edn. (University of Western Australia Press: Nedlands, WA.)

Botanical Museum Berlin-Dahlem (1999). *List of families including extant collections of the Botanical Museum Berlin-Dahlem (B) from the time before 1943*. http://www.bgbm.fu-berlin.de/BGBM/research/colls/herb/phanerog.htm [accessed January 2011]

Diels, L. & Pritzel, E (1904). Fragmenta phytographiae Australiae Occidentalis. *Botanische Jahrbucher* 35: 480–481.

Keighery, G.J. (1996). Phytogeography, biology and conservation of Western Australian Epacridaceae. *Annals of Botany* 77: 347–355.

Lyons, M. (2008). *A study into the risk of Phytophthora dieback in Ten Peri-urban Reserves within the Shire of Denmark.* (Project Dieback: Perth.)

Smith, M.G. (2010). *Declared Rare and Priority Flora List for Western Australia.* (Dept of Environment and Conservation: Kensington, WA.)

Stafleu, F.A. & Cowan, R.S. (1976). *Taxonomic literature*. Vol. 1. 2nd ed. (Bohn, Scheltema & Holkema: Utrecht.)

Stuppy, W. (2004). *Glossary of seed and fruit morphological terms*. (Seed Conservation Department, Royal Botanic Gardens: Kew, England.)

Wheeler, J., Marchant, N. & Lewington, M. (2002). *Flora of the south west: Bunbury-Augusta-Denmark.* Vol 2, Dicotyledons. (Australian Biological Resources Study: Canberra.)